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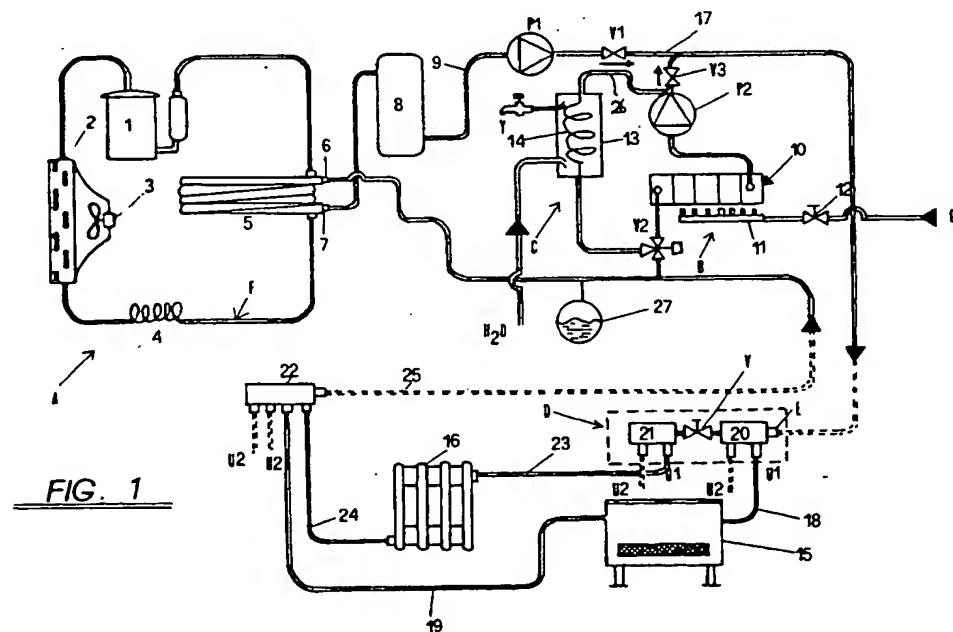
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#### 54 Monobloc heating and cooling system.

57) The monobloc heating and cooling system groups in a single block the refrigerating and heating units (A,B) and comprises manifolds (D) formed of two sections (20,21) connected to each other by valving means (V) A single hydraulic circuit (17,25)

is provided which connects the single block to the manifolds (D) and the manifolds (D) to the heating and cooling elements (16,15) provided for heating and cooling the rooms.



The present invention generally relates to room heating and cooling systems and, more particularly, to an improved system of this kind.

It is known that, when a room is to be heated and also conditioned, two independent hydraulic circuits must be provided, namely a circuit for the circulation of hot water and a circuit for the circulation of cold water. Alternatively, a hydraulic circuit for the circulation of hot water and coolant pipes for a direct expansion cold exchanger can be provided. However, in both cases it is necessary to connect the heating and/or cooling elements by means of four pipes.

Therefore, in the self-contained systems of small capacity (for example for a single family) it is necessary to have a boiler and a water refrigerator (or a two-section apparatus in the case of the direct expansion system) each of which is provided with an own electric and hydraulic supply and with an own regulation.

During the winter season in which the room heating is necessary, all the rooms are usually to be heated, but during the summer season in which the room conditioning is necessary, some rooms, as for example the bath-rooms, store-rooms, not frequently used rooms and so on, are not conditioned. This involves operation characteristics as to the power, the pump delivery, the pressure losses, the distribution and so on, which are quite different in both the systems.

With the exception of particular regulation cases especially provided by persons very skilled in this art and having a good knowledge of the operation problems of these systems, each system has the own regulation and the switching from the heating mode of operation to the cooling mode of operation or viceversa occurs by hand, after the shut-down of one of the two systems.

If, as happens, there would be provided a single system, operating either with hot water or cold water produced by respective and separate generators which are parallel connected and by using heating elements of different kind (radiators and fancoils), there is the need of decreasing the water temperature in the fancoils or to install heat radiators having a greater surface.

This invention aims at providing a monobloc heating and cooling system which obviates the above mentioned disadvantages.

Another object of the present invention is to provide a monobloc heating and cooling system permitting the use of the same heat exchange elements as those located in the rooms to be heated and conditioned in each of two operating modes.

Still another object of the present invention is to provide a monobloc heating and coolig system of a very semplified kind and requiring only a

hydraulic circuit both for the heating mode of operation and for the cooling mode of operation.

A further object of the present invention is to provide a monobloc heating and cooling system which permits an automatic switching from one operating mode to the other operating mode.

According to the invention, the room heating and cooling system comprises a water refrigerating unit, a water heating unit, if necessary a water heater for the sanitary appliances, circulation pumps, safety and control means and heating and cooling elements and is characterized in that

- the water refrigerating unit, the water heating unit, the circulation pumps, the water heater for the sanitary appliances and the safety and control means are grouped in a single block;
- manifolds are provided each of which consists of two sections connected to each other through a valving means; and
- a single hydraulic circuit is provided both for the heating mode of operation and the cooling mode of operation.

According to another feature of the present invention, said manifolds are connected to the single block and to the heating and cooling elements by means of two pipes only, one pipe for delivering the heating and cooling medium and the other pipe for returning it.

According to another feature of the present invention, in the operating mode with high temperature of the hot water, the cooling elements are provided with shutter means for operating only a portion thereof, when they are acting as heating elements.

According to a further feature of the present invention, in the operating mode with a low temperature of the hot water, the manifolds are connected in groups of two and one manifold of each group has a temperature control valve of the cooling elements so as to maintain this temperature low when they are acting as heating elements and automatically control the temperature according to the thermal load.

According to still another feature of the present invention, radiators as heating elements and fancoils as cooling and heating elements, respectively can be used for the rooms that are to be only heated or cooled and heated, respectively.

The present invention will be now described in more detail in connection to a preferred embodiment thereof, given only by way of example and therefore not intended in a limiting sense, illustrated in the accompanying drawings, wherein:

Fig. 1 diagrammatically shows a circuit of the monobloc room heating and cooling system according to the present invention;

Fig. 2 diagrammatically shows a circuit of the arrangement of the manifold according to the

invention during the operating mode with high temperature of the hot water; and

Fig. 3 diagrammatically shows a circuit of the arrangement of the manifolds according to the invention during the simultaneous operation with low temperature of the hot water in the fancoils and high temperature in the heat radiators.

As can be seen from Fig. 1, the monobloc heating and cooling system according to the present invention essentially comprises a refrigerated water generating unit or refrigerating unit A, a hot water generating unit or boiler B, a water heater C for the sanitary appliances and manifolds D of special design.

The refrigerating unit A conventionally comprises a compressor 1, a condenser 2 provided with fan 3, a laminating element 4 and an evaporator 5. The evaporator 5 has an inlet 6, an outlet 7 for the circulating water. The outlet 7 is connected to a refrigerated water accumulator 8.

The hot water generating unit B comprises a gas boiler 10 provided with burners 11 supplied by a gas source G through a gas valve 12.

The water heater C comprises a tank 13 connected to a water supply and containing a coil 14 in which the hot water coming from the gas boiler 10 circulates and which heats the water supplied thereto.

The manifolds D are formed of two separate sections 20 and 21 connected to each other through an ON-OFF valve V. They have a single inlet E which is to be connected to the hot water delivery of the boiler 10 or the cold water delivery of the accumulator 8. Both outlets are connected to the users, i.e. the heating elements and the cooling elements, for example the outlet U1 of the manifold section 20 is connected to a fancoil and the outlet U1 of the manifold section 21 is connected to a heat radiator and the outlets U2 are connected to another heat radiator and another fancoil. Although only two outlets have been shown for simplicity, it should be apparent that the outlet number is depending on the number of users provided in the system.

As can be seen from the embodiment illustrated in Fig. 1, the refrigerated water flowing from the accumulator 8 is circulated by a circulation pump P1 through the pipe 9 and then, through the pipe 17 in which an one-way valve V1 is located, is supplied to the inlet E of the section 20 of the manifold D. The outlet U1 of the manifold D is connected, through the pipe 18, to the fancoil 15, the outlet of which is connected, through a pipe 19, to a return manifold 22. The outlet U1 of the section 21 of the manifold D is connected, through a pipe 23, to the heat radiator 16, the outlet of which is also connected, through a pipe 24, to the return manifold 22. The return manifold 22 returns,

through the pipe 25, the circulating water to the inlet 6 of the evaporator 5 in order that this water is again refrigerated at the correct outlet temperature.

The hot water coming from the boiler 10 is circulated by the circulation pump P2, through the pipe 26 in the water heater C. The hot water flows then through the coil 14 and returns to the boiler 10 through a three-way valve V2. The hot water is also delivered by the circulation pump P2, through an one-way valve V3, to the pipe 17 leading to the manifolds D. The pipe 25 from the return manifold 22 can be communicated with the boiler 10 through the three-way valve V2. In the return pipe 25 an expansion tank 27 is provided.

The operation of the just described system is as follows.

As already said at the beginning, in each of the rooms to be only heated a heat radiator is provided, whereas in the rooms which are also to be conditioned a fancoil is provided.

Assume now to be in the winter season, in which all the rooms are to be heated. In this case the circulation pump P1 is inoperative and the boiler 10 delivers the hot water generated thereby through the circulation pump P2, the one-way valve V3, the pipe 17, to the section 20 of manifold D, the ON-OFF valve V of which is now in open position, so that the hot water enters the manifold section 20 through the single inlet E and flowing from the outlet U1, is supplied to the fancoil 15 through the pipe 18. Because the ON-OFF valve V is open, the hot water enters also the section 21 of the manifold D and flowing from the outlet U1 is supplied, through the pipe 23, to the heat radiator 16. The water flowing from the fancoil 15 and the water flowing from the heat radiator 16 is supplied to the return manifold 22 which returns it, through the pipe 25, to the boiler 10, through the three-way valve V2 which communicates now the boiler 10 to the return pipe 25. The hot water can flow also in the water heater C and is returned to the boiler 10 through the three-way valve V2 which, when necessary, is automatically switched to communicate also the water heater C with the boiler 10.

Assume now to be in the summer season so that only the rooms provided with fancoils are to be conditioned. In this case, the boiler operates for preparing the hot water for the sanitary appliances, but it is excluded from the hydraulic circuit to the users by switching the three-way valve V2, so that the latter communicates only the water heater with the boiler. In this case, the circulation pump P1 is made operative and therefore the refrigerated water contained in the accumulator 8 is supplied through the one-way valve 1 to the section 20 of the manifold D, whereas the manifold section 21 is excluded by closing the ON-OFF valve V. The refrigerated water flows from the outlet U1 of the

section 20 of the manifold D and, through the pipe 18, is supplied to the fancoil 15 from which it flows in order to be supplied to the return manifold 22 through the pipe 19. From the return manifold 22 the water which has exchanged its refrigeration contents with the environment, is returned through to the pipe 25 to the inlet 6 of the evaporator 5 of the refrigerating unit A.

As can be seen, in order to operate the system both in the heating mode and in the cooling mode always a single hydraulic circuit is employed. It comprises two pipes one of which, namely the pipe 17, is directed to the manifold D and the other of which, namely the pipe 25, returns the circulating water to the hot water generating unit B and to the refrigerating unit A, respectively. Also the users are arranged in a single hydraulic circuit leading to manifolds D.

In Fig. 2 there is diagrammatically shown a circuit to be employed in the system according to the present invention in the heating mode of operation with high temperature of the hot water. Also in this case, all the rooms to be heated are provided with a heat radiator and the rooms to be conditioned are provided with a fancoil.

As can be seen, the hot water at the temperature of about 80 °C coming from the boiler 10 and circulated by the circulation pump P2 enters, through the single inlet E the section 20 of the manifold D and through the outlet U1 of the manifold section 20, flows in the fancoil 15 at this high temperature. In this operating mode the ON-OFF valve V is open and the hot water at a temperature of 80 °C enters also the section 21 of the manifold D and through the outlet U1, flows in the radiator 16 for heating the rooms not provided with a fancoil. In this case in the fancoil 15 provided with fan 29 a two-circuit battery 28 is provided and in the pipe 18 a shutter V4 is arranged the function of which is to permit the flow of the hot water through one circuit 30 of the two circuit battery 28, thereby excluding the other circuit 31. In this manner the water circulating in the fancoil 15 is cooled so as to impart to the air flowing from the fancoil a not too high temperature, but sufficient to heat the room environment.

On the contrary, in the case that the room environment is to be conditioned, the ON-OFF valve V of the manifold D is turned off so as to exclude the manifold section 21 and the refrigerated water coming from the pipe 17 is supplied in the fancoil 15, which, in this case, has the shutter V4 open so as to supply both the circuit 31 and the circuit 30 so as to operate all the battery 28.

In Fig. 3 there is diagrammatically shown a circuit intended to be employed in the system according to the present invention in the heating operating mode with low temperature of the hot

water. Here again all the rooms to be heated are provided with heat radiators, whereas the rooms to be also conditioned are provided with fancoils. In this case an integrated manifold (high-low temperature) designated by C1 is provided, which comprises two parallel arranged manifolds D one of which, namely the manifold D1, is provided with the ON-OFF valve V and the other of which, namely the manifold D2, is provided with a thermostatic valve VT for regulating the temperature of the fancoil 15. In this case the inlets E of the sections 20 of the manifolds D1,D2 are connected to each other by a pipe 32 in which a circulation pump P3 for the low temperature elements is inserted. The ON-OFF valve V is open so that the water at a temperature of 80 °C entering through the inlet 33 of the section 20 of the manifold D1 flows through the manifold section 21 and is supplied, through the pipe 34, to the heat radiator 16 and the less hot water flowing therefrom enters the section 21 of the manifold D2 through the pipe 35 and is returned to the boiler through the pipe 25.

The water in the section 20 of the first manifold D1, after being mixed with the water coming from the pipe 32, is supplied to the fancoil 15 through the pipe 36 from which is then supplied to the section 20 of the second manifold D2 and circulated by the pump P3 continuously in the fancoil 15 through the pipes 32 and 36. The control thermostatic valve VT is controlled according to the temperature in the section 20 of the second manifold D2 and has the function of maintaining low the hot water temperature supplied to the fancoils and of automatically controlling it according to the thermal load.

Of course, in the summer season in which only the fancoil 15 is to be operated, the boiler 10 is disconnected, the ON-OFF valve V of the first manifold D1 is closed and the pump P3 is inoperative so that the refrigerated water coming from the accumulator 8 flows in the manifold section 20, through the fancoil 15 and from the return pipe 25 through the second manifold D2 and the valve VT which is in open position.

As can be understood from the description, the monobloc heating and cooling system according to the present invention permits both the heating elements and the cooling elements to be supplied by means of two pipes only, which extend from the refrigerated water and the hot water generating units to the special manifolds and from here, always by means of two pipes, to the users. Furthermore, the generating units are grouped in a single block which can include also the control and regulation elements arranged in a center unit and this single block can be arranged outdoor, if desired.

It should be understood that in the above described monobloc heating and cooling system the

valves can be controlled by hand or automatically by the center unit provided in the single block and also the switching from the heating operate mode to the cooling operate mode can be automatically controlled.

Furthermore, the manifolds can have a configuration different from that illustrated provided they operate in the described manner.

The above described system permits the following advantages to be obtained:

- 1) Simplified construction because the monobloc heating and cooling system comprises the electric and hydraulic connections present in only one of the two systems (heating and conditioning). This permits a space recovery and offers the possibility to arrange outdoor the monobloc heating and cooling system containing the hot water and refrigerated water generating units.
- 2) Possibility of using the same heating and cooling elements in the rooms to be heated and conditioned in its of the two operating modes, resulting in the use of two pipes only, which extend from the hot water and cold water generating units to the manifolds and from the latter to each heating and cooling element.
- 3) Automatic disconnection of the heating elements in the rooms not of concern during the conditioning period.
- 4) Automatic adaptation to the different system characteristics in both the operating modes of the pump which circulates the heating medium because each operating mode is provided with the own pump designated for the specific purpose.
- 5) Automatic regulation of the water temperature during the operation in the heating mode in the heating elements adapted to low temperature.
- 6) Automatic and central regulation and switching of the operation.
- 7) Modularity and freedom of choosing the number and the type of the terminal users.
- 8) Possibility of arranging all the control and regulating elements in a single place, preferably in said single block.

## Claims

1. Monobloc room heating and cooling system comprising a water refrigerating unit (A), a water heating unit (B), if necessary a water heater (C) for the sanitary appliances, circulation pumps (P1,P2,P3), safety and control means and heating and cooling elements (16,15), characterized in that
  - the water refrigerating unit (A), the water heating unit (B), the circulation pumps (P1,P2,P3), the water heater (C) and the

5 safety and control means are grouped in a single block;

- manifolds (D) are provided consisting of two sections (20,21) connected to each other through a valving means (V); and
- a single hydraulic circuit is provided both for the heating mode of operation and the cooling mode of operation.

- 10 2. Monobloc system according to claim 1, characterized in that said manifolds (D) are connected to said single block and to said heating and cooling elements (16,15), respectively by means of two pipes only (17,25), one of which (17) delivers the heating and cooling medium and the other of which (25) is provided for the return thereof.
- 15 3. Monobloc system according to claims 1 and 2, characterized in that in the operating mode with high temperature of the hot water, said cooling elements (15) are provided with shutter means (V4) for operating only a portion thereof, when they are acting as heating elements.
- 20 4. Monobloc system according to claims 1 and 2, characterized in that in the operating mode with a low temperature of the hot water, said manifolds (D1,D2) are connected in groups of two and one manifold (D1) of each group has a temperature control valve (VT) of the cooling elements (15) so as to maintain this temperature low when they are acting as heating elements and automatically control the temperature according to the thermal load.
- 25 5. Monobloc system according to claim 1, characterized in that heat radiators (16) as heating elements and fancoils (15) as cooling and heating elements, respectively can be used for the rooms that are to be only heated or cooled and heated, respectively.

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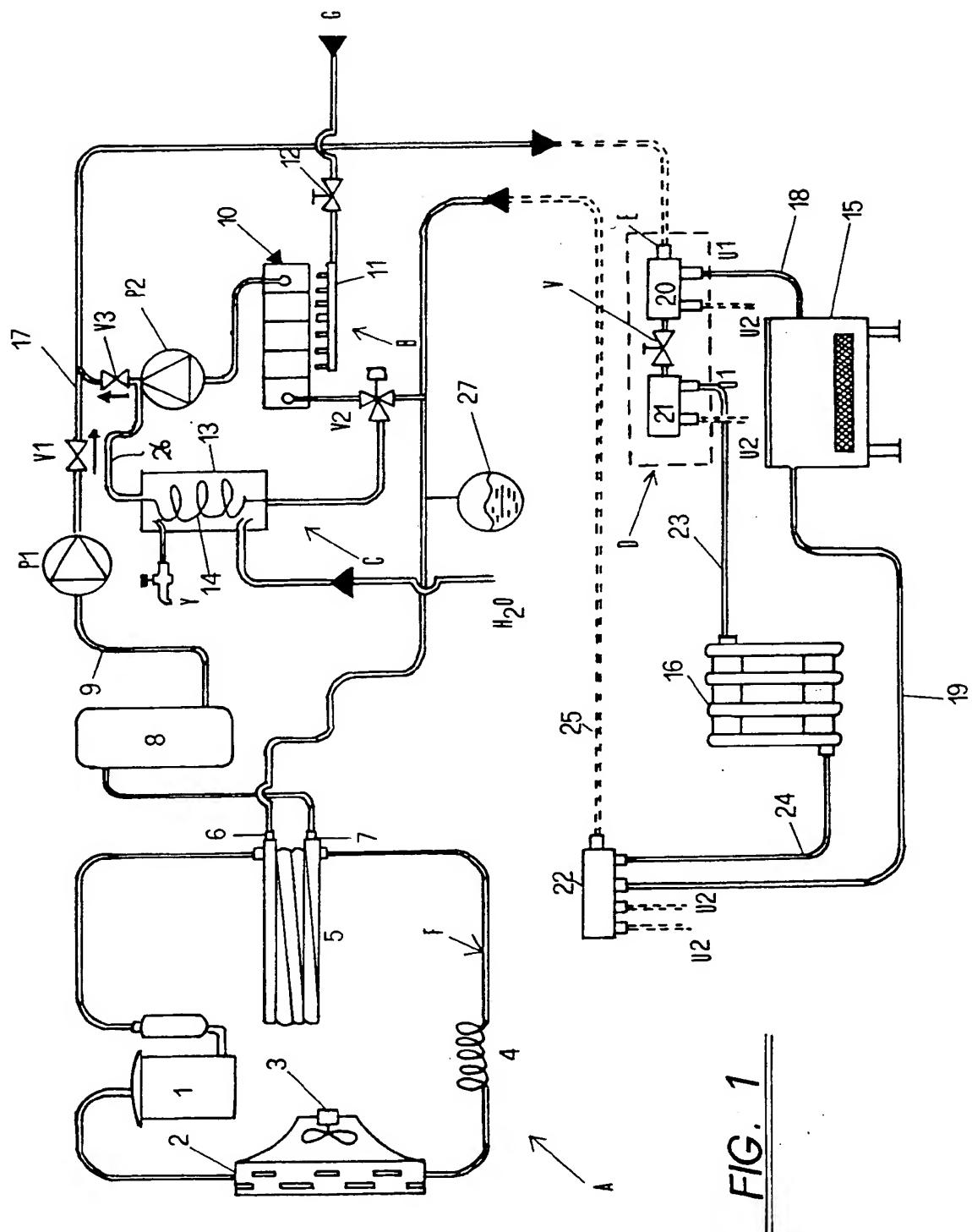


FIG. 1



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## EUROPEAN SEARCH REPORT

**Application Number**

EP 92 10 5383

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D, X	US-A-2 121 625 (CRAGO)	1	F24F5/00
A	* page 1, column 2, line 52 - page 2, column 1, line 32; figure 1 *	3-5	F24D3/18
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D, A	US-A-3 425 485 (NEWTON)	1-3	
	* column 3, line 4 - column 4, line 17; figures 1-3 *		
	---		
A	US-A-2 984 460 (GARDNER)	1.2	
	* column 3, line 66 - column 5, line 43; figures 4,5,7 *		
	---		
A	DE-A-2 140 018 (KÄLTE-WÄRME-KLIMATECHNIK)	1,6	
	* claims 1-7; figures 1,2,4 *		
	---		
A	US-A-3 906 742 (NEWTON)		
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A	US-A-4 798 240 (GERSTMANN ET AL.)		
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			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F24F F24D

The present search report has been drawn up for all claims

Place of search <b>THE HAGUE</b>	Date of completion of the search <b>03 JULY 1992</b>	Examiner <b>PESCHL G.</b>
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**CATEGORY OF CITED DOCUMENTS**

X : particularly relevant if taken alone  
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 A : technological background  
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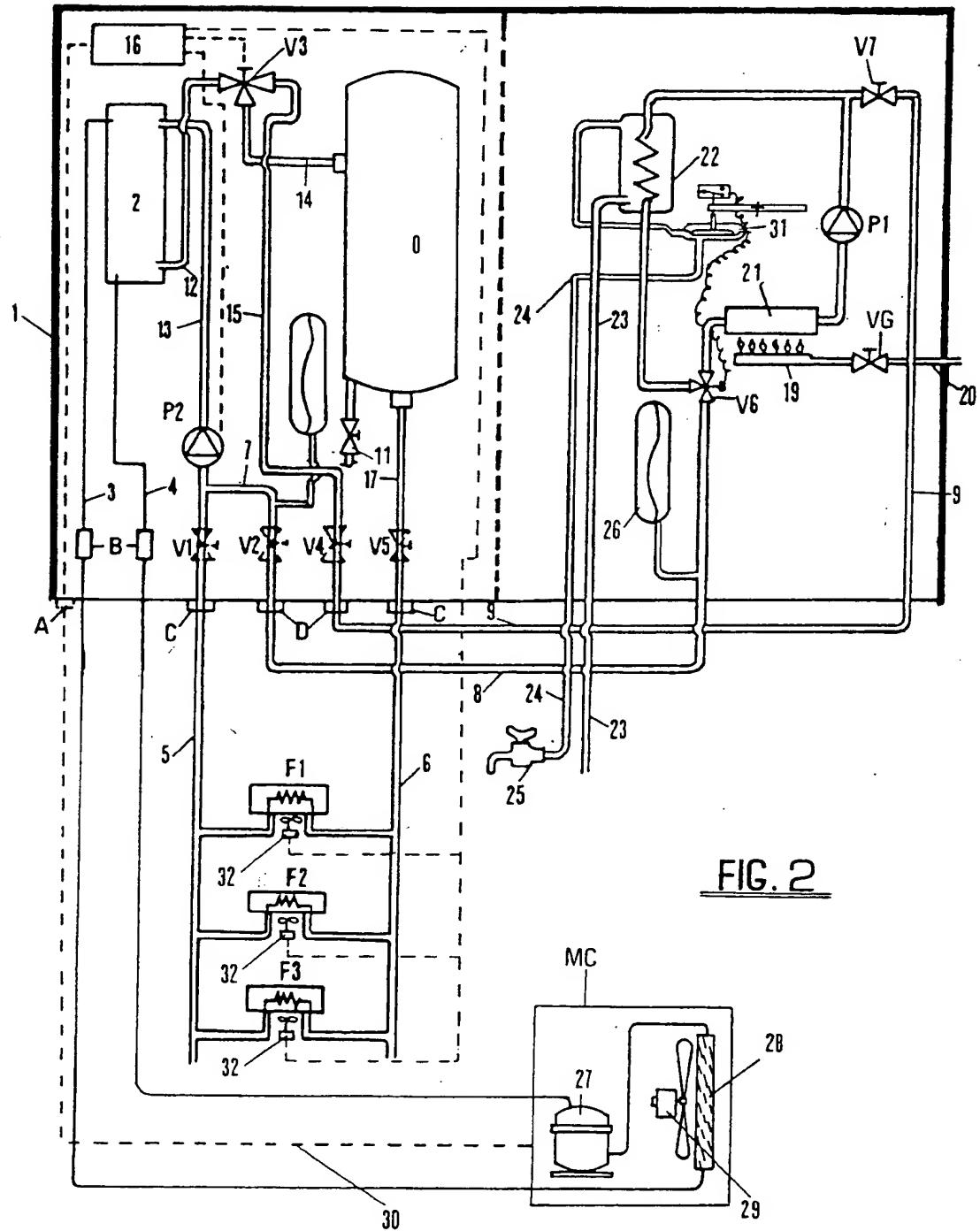


FIG. 2

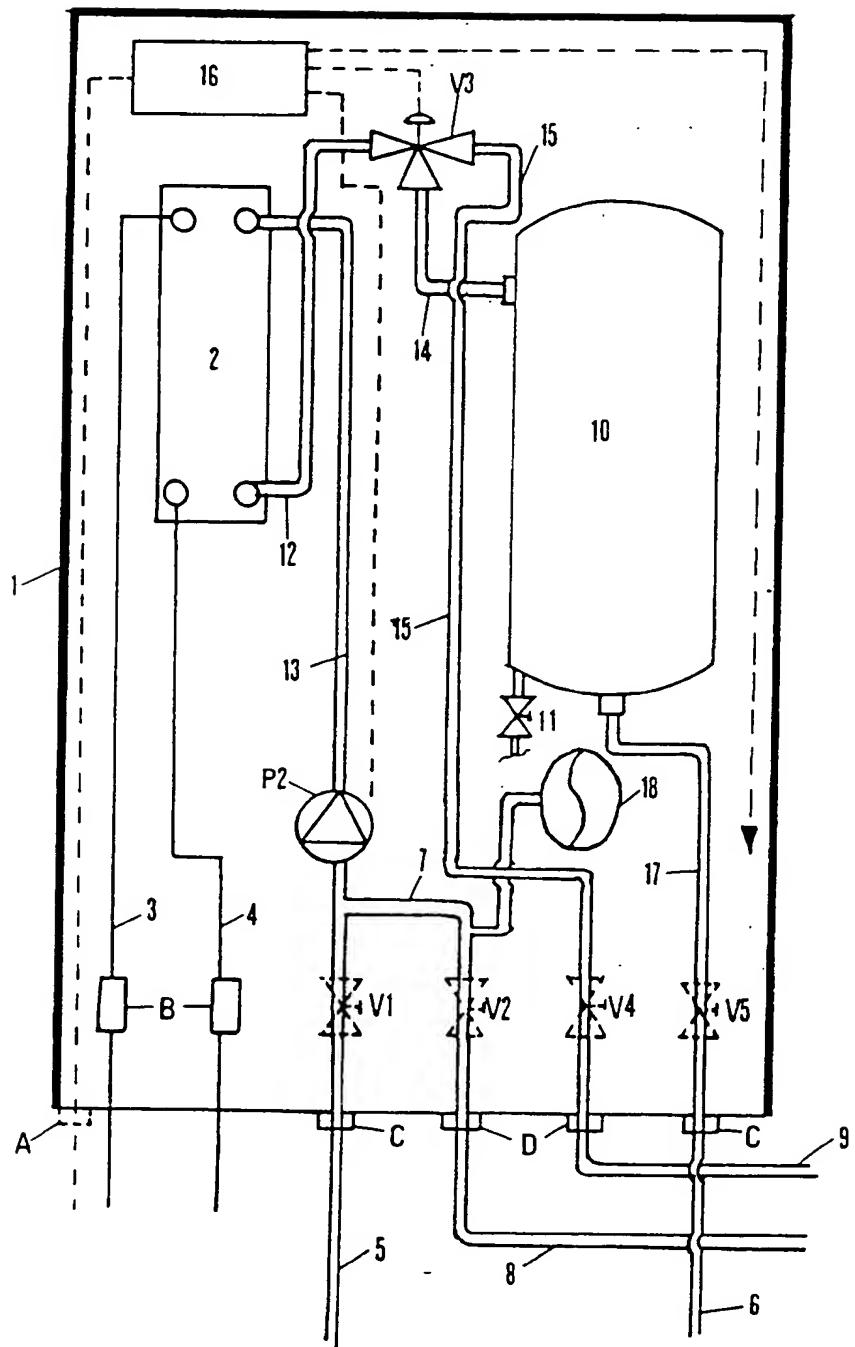


FIG. 1

connected to wall-mounted gas-fired boilers (typical of a multi-family heating system) or is provided with conventional means for mounting it to a floor if it is to be connected to floor-mounted gas-fired boilers (typical of a single family heating system). Alternatively, the cooling module according to the present invention can be enclosed in a single common housing 1 so as to form an integrated appliance which combines room heating and cooling and potable water heating in a single compact package and which provides these functions with a minimum operating cost.

The advantages offered by the cooling module according to the present invention to be associated to a boiler, preferably a gas-fired boiler are the following:

- 1) Since the cooling module contains all the necessary components for enabling the connection to the single hydraulic circuit leading to the fancoils and the easy connection to the external motor-operated chilling unit, this module can be sold as self-contained apparatus which can be purchased on the market ready to be associated to a boiler, preferably a gas-fired boiler.
- 2) It can be enclosed in a single common housing together with the boiler, preferably a gas-fired boiler, so as to improve the aesthetical appearance of the heating and cooling system of the multi-family or single-family dwelling unit and to form an integrated appliance which combines room heating and cooling and potable water heating in a single compact package.
- 3) Since the motor-operated chilling unit, which is a source of noise, is located in the outside there are not problems of freezing of the connecting pipes during the winter period, because they do not contain water, but frigorific fluid which does not freeze.
- 4) The provision of an accumulator of hot and cold water permits a greater flexibility of the heating and cooling system and a correct operation both of the boiler in the winter period and of the cooling module in the summer period.
- 5) Possibility to mount the cooling module to a wall when it is employed together with a wall-mounted boiler, preferably a gas-fired boiler or to mount the cooling module on the floor when it is employed together with a floor-mounted boiler, preferably a gas-fired boiler.
- 6) Possibility of operating the fans of the fancoils separately from each other for cooling only the rooms in which people is living, thus saving operating costs of the heating and cooling system of the multi-family or single-family dwelling unit.

## Claims

1. Cooling module to be associated to boilers, preferably gas-fired boilers of independent heating systems for multi-family or little single-family dwelling units having fancoils (F1,F2,F3...) as heating and cooling terminals and a single hydraulic circuit (5,6) leading thereto, characterized in that it comprises:
  - a heat exchanger (2) acting as an evaporator of a frigorific system,
  - a circulation pump (P2) for the cold water,
  - an accumulator (10) of heating and/or cooling medium,
  - a switching valve (V3) for connecting said single hydraulic circuit (5,6) to said boiler during the winter period and to the cooling module during the summer period,
  - a motor-operated chilling unit (MC) to be arranged outdoor, and
  - connecting means (A,B,C,D) for connecting said cooling module to said boiler, for connecting said heat exchanger (2) to said external motor-operated chilling unit (MC) and for connecting said module to said single hydraulic circuit (5,6) leading to the fancoils (F1,F2,F3...).
2. Cooling module according to claim 1, characterized in that it further comprises a central control unit (16) for controlling said circulation pump (P2), said switching valve (V3), said external motor-operated chilling unit (MC) and the fans (32) of the fancoils (F1,F2,F3...).
3. Cooling module according to claim 2, characterized in that said central control unit (16) includes conventional means for separately controlling each of said fans (32) of the fancoils (F1,F2,F3...).
4. Cooling module according to claim 1, characterized in that said heat exchanger (2) is of the counterflow water-frigorific fluid type.
5. Cooling module according to claim 1, characterized in that said heat exchanger (2) is a plate type heat exchanger.
6. Cooling module according to the preceding claims, characterized in that it includes conventional means for inverting the frigorific cycle in order to operate the module as a heat pump for providing the heating of the rooms in the winter period and the cooling of the rooms in the summer period.

useful when there is not the possibility of installing a boiler for heating purpose. In fact, in this case, the mere installation of the cooling module according to the present invention gives the possibility of obtaining, in addition to the cooling of the rooms, the heating thereof, because by inverting the frigorific cycle of this module, it can operate as a heat pump so that the heat exchanger 2 therein included provides hot water instead of cold water.

In order to associate to the gas boiler the cooling module according to the present invention, the boiler supply pipe 9 is connected to the pipe 15 of the cooling module and the boiler return pipe 8 is connected to the pipe 7 of the cooling module and this through the fittings D.

The external motor-operated chilling unit MC is connected to the conduits 3 and 4 leading to the cooling module through the quick-coupling fittings B and is connected to the central control unit 16 through the electric connector A.

The cooling module is connected to the supply and return pipes 5 and 6 of the single hydraulic circuit leading to the fancoils F1,F2,F3... through the fittings C.

Once these connections have been made, the unit comprised of gas boiler and cooling module is ready to operate either in the winter period or in the summer period.

#### OPERATION IN THE WINTER PERIOD

During the winter period the gas boiler operates for heating the rooms of each multi-family or single-family dwelling unit and the water contained in the single hydraulic circuit 5,6 leading to the fancoils F1,F2,F3... is circulated by the pump P1 delivering it through the heat exchanger 21 provided with the set of burners 19 and then both to the hot water heater 22 for the domestic hot water and to the boiler supply and return pipes 9,8 leading to the cooling module, through the ON-OFF valves V7 and V4 which are now ON. The water flowing out from the hot water heater 22 returns, through the three-way valve V6, to the heat exchanger 21.

The three-way valve V3 of the cooling module is now switched so as to communicate the boiler supply pipe 9 through the valve V4 and the pipe 15 of the cooling module, to the accumulator 10 which is filled with hot water and so acts as a hot water accumulator. This hot water flows out from the accumulator 10 through the pipe 17 and the valve V5 and enters the supply pipe 6 of the hydraulic circuit leading to the fancoils F1,F2,F3..., whereas the return pipe 5 of this hydraulic circuit is connected through the pipe 7 and the valve V2 to the boiler return pipe 8. The hot water then can circulate in the fancoils F1,F2,F3... and therefore

heats the rooms, while the cooling unit contained in the module according to the present invention is cut off by the three-way valve V3. The central control unit 16 does not energize the pump P2 and the external motor-operated chilling unit MC.

#### OPERATION IN THE SUMMER PERIOD

During the summer period the ON-OFF valve 10 V7 of the gas boiler is OFF and the motor-operated chilling unit MC connected to the heat exchanger 2 of the cooling module is operated by the central control unit 16 so as to circulate the frigorific fluid in the heat exchanger 2 through the supply and return conduits 3 and 4. The three-way valve V3 of the cooling module is switched by the central control unit 16 so as to connect the outlet pipe 12 of the heat exchanger 2 to the accumulator 10 through the pipe 14. The central control unit 16 operates the pump P2 so as the accumulator 10 is filled with the cold water cooled by the heat exchanger 2. The accumulator 10 acts now as an accumulator of cold water which flows out through the pipe 17 and the valve V5 for entering the supply pipe 6 of the hydraulic circuit leading to the fancoils F1,F2,F3.... The valve V2 is closed to cut off the boiler supply pipe 9 and so the hot water coming from the heat exchanger 21 can flow only in the hot water heater 22 of the domestic hot water also in the summer period whenever it is taken from the cock 25. The operation of the pump P2 causes the circulation of the cold water, cooled by the heat exchanger 2, in the hydraulic circuit leading to the fancoils F1,F2,F3.... The cold water, after being flowed through the fancoils F1,F2,F3... is returned through the return pipe 5 to the cooling module in order to be recirculated through the heat exchanger 2 by the pump P2.

Since the fans 32 of the fancoils F1,F2,F3... are separately operated by the central control unit 16, there is the possibility to cool in the summer period either all the rooms of the multi-family or single-family dwelling unit or only those rooms wherein people is living. For example, during the day only the living room can be cooled by operating the fan 32 of the fancoil located in the living room and during the night only the bed room can be cooled by operating the fan 32 of the fancoil located in the bed room, while the cold water is circulated in all the fancoils.

Of course, the cooling module includes in a manner per se known also all the safety devices required by the accident prevention specifications, and a safety device preventing the operation of the motor-condensing unit MC if the pump P2 is not operating.

The cooling module is provided with conventional means for mounting it to a wall if it is to be

- a heat exchanger acting as an evaporator of a refrigeric system,
- a circulation pump for the cold water,
- an accumulator of heating and/or cooling medium,
- a switching valve for connecting said single hydraulic circuit to said boiler during the winter period and to the cooling module during the summer period,
- a motor-operated chilling unit to be arranged outdoor, and
- connecting means for connecting said cooling module to said boiler, for connecting said heat exchanger to said external motor-operated chilling unit and for connecting said module to said single hydraulic circuit leading to the fancoils.

The present invention will be described in more detail in connection to the accompanying drawings, wherein:

Fig. 1 diagrammatically shows a preferred embodiment of the cooling module according to the present invention; and

Fig. 2 shows the cooling module of Fig. 1, associated to a wall-mounted gas-fired boiler in order to form the heating and cooling system for multi-family or single-family dwelling units.

As can be seen in Fig. 1, the cooling module according to the present invention comprises a housing 1 containing, in an internal hydraulic circuit, a circulation pump P2 and a heat exchanger 2 acting as an evaporator of a refrigeric system and arranged downstream from the circulation pump P2. This heat exchanger 2 is suitably insulated so as to avoid the effects of the condensate on the outer surfaces thereof. Downstream from the heat exchanger 2 an accumulator 10 is arranged, which is externally insulated. This accumulator 10 is provided with a discharge valve 11. Upstream the accumulator 10 a three-way valve V3 is arranged. This three-way valve V3 is connected to the outlet pipe 12 of the heat exchanger 2 and to the inlet pipe 14 of the accumulator 10 and finally, through the pipe 15, to the supply pipe 9 of the boiler to be associated to the cooling module. The accumulator 10 is connected to the supply pipe 6 of the single hydraulic circuit leading to the fancoils through the pipe 17. The inlet pipe 13 of the heat exchanger 2 of the cooling module is connected to the return pipe 5 of the single hydraulic circuit leading to the fancoils. Upstream from the circulation pump P2 the inlet pipe 13 is connected, through a pipe 7, to the boiler return pipe 8. This pipe 7 is provided with an expansion tank 18 for compensating the thermal expansions and contractions of the heating/cooling medium.

The cooling module has also a pair of quick-coupling fittings B for connecting the heat exchang-

er 2 to an external motor-operated chilling unit MC (which will be described later), as well as a pair of fittings C for the connection of the single hydraulic circuit leading to the fancoils and a pair of fittings D for the connection to the gas-fired boiler.

In the pipes 7,15 connecting the cooling module to the gas-fired boiler and in the pipes 5,6 of the cooling module leading to the fancoils ON-OFF valves V2 and V4, V1 and V5, respectively, are disposed.

As already said, the heat exchanger 2 of the cooling module is intended to be connected to an external motor-operated chilling unit MC (Fig. 2), by means of a supply conduit 3 and a return conduit 4 through the quick-coupling fittings B. This motor-operated chilling unit MC comprises a compressor 27, a condenser 28 and a fan 29 of a refrigeric system. The supply and return conduits 3,4 connecting the motor-operated chilling unit MC to the heat exchanger 2 of the cooling module are preferably enclosed in a flexible tube. Also in this flexible tube an electric cable 30 is included for the electrical connection of the motor-operated chilling unit MC to a central control unit 16 included in the cooling module which, to this purpose, is provided with an electric connector A.

The central control unit 16 is provided for controlling, in addition to the external motor-operated chilling unit MC, also the three-way valve V3, the circulation pump P2 and the fans 32 of the fancoils, as shown by dotted lines in Fig. 2.

In Fig. 2 the cooling module of the present invention is shown associated to a wall-mounted gas-fired boiler.

As known, the boilers of this type include an internal hydraulic circuit in which there are disposed a heat exchanger 21, a set of burners 19 which are fed by the gas coming from the pipe 20 in which an ON-OFF valve VG is arranged, a circulating pump P1, a hot water heater 22 for the domestic hot water which enters the pipe 23 and flows out from the pipe 24 through the cock 25, an expansion tank 26 and a three-way valve V6, as well as an ON-OFF valve V7 for excluding the boiler during the summer period. The boiler comprises also the supply pipe 9 and the return pipe 8 for connecting it to the cooling module. The three-way valve V6 is controlled by a transducer 31 inserted in the outlet pipe 24 of the domestic hot water heater 22. This transducer 31 automatically switches the three-way valve V6 so as to communicate the hot water flowing out the heat exchanger 21 to the hot water heater 22 whenever the cock 25 is opened for the delivery of the domestic hot water.

The cooling module according to the present invention can be provided with conventional means for inverting the refrigeric cycle. This is particularly

This invention relates to heating systems for dwelling units, particularly multi-family dwelling units, such as flats, or little single-family units, such as cottages or the like and, more particularly, to a cooling module to be associated to a boiler, preferably a gas-fired boiler of so called "independent central heating systems" for permitting the heating system to be operated in the heating mode during the winter period and in the cooling mode during the summer period.

It is known that when a dwelling unit is to be heated and also cooled, two independent hydraulic circuits are necessary, in one of which hot water is circulated and in the other of which cold water is circulated.

Therefore, in such heating and cooling systems it is necessary to have a boiler and a cooling unit which are each provided with its own electric and hydraulic supply and its own control system.

During the winter period in which the heating is required, all the rooms of each dwelling unit are to be heated. However, during the summer period in which the cooling is required, some rooms of each dwelling unit, such as bath-room, lumber room, often not used rooms and so on do not need to be cooled. This requires operating characteristics very different in both the systems as to the capacity, the pump flow rate, the pressure drop, the distribution and so on.

To overcome this disadvantage, systems are developed which are designed both for heating and cooling purposes by employing always the same hydraulic circuit. In these systems, to the boiler a cooling unit is associated which in the summer period operates for circulating in the single hydraulic circuit the cold water by excluding the boiler and in the winter period is excluded for circulating in this single hydraulic circuit the hot water.

The US-A-2,121,625 discloses a heating and cooling system employing a single heat exchanger both for heating and for cooling. Such heat exchangers are arranged in the rooms to be heated or cooled and are provided with a fan for circulating the air in the rooms. This heating and cooling system comprises a boiler and a conventional cooling apparatus and the heat exchangers are connected both to the boiler and to the cooling apparatus through a single hydraulic circuit formed of two pipes in which ON-OFF valves are arranged. In the winter period hot water coming from the boiler is circulated in the single hydraulic circuit, whereas in the summer period cold water coming from the cooling apparatus circulates in the single hydraulic circuit. This system is designed to be used in multiflat-buildings and the boiler and the cooling apparatus are located in the basement of the building.

The US-A-3,425,485 discloses a control system

for a single-pipe air conditioning system in which heated and chilled water is alternately supplied to a plurality of room air handling units. The water supplied to these units is circulated through a heat exchanger in the air handling units by means of a pump which is intermittently operated. The pump is located in the inlet line of each air handling unit and is operated when the room requires cooling and chilled water is available and when the room requires heating and heated water is available.

The above mentioned heating and cooling systems are central heating and cooling systems and comprise a plurality of heat exchangers each of which is arranged in a room of the various dwelling units, and all of which are connected to a single boiler and a single cooling apparatus.

In the last years, in the heating systems for multi-family or little single-family dwelling units a gas-fired boiler is preferably employed which circulates the heating water through the heat exchanger units located in the rooms of the dwelling unit through one hydraulic circuit. The gas-fired boilers can be wall-mounted type or floor-mounted type and are provided also with a heater for the potable hot water.

From the US-A-2,121,625 and the US-A-3,425,485 no teachings can be taken on the manner in which the heating and cooling systems therein described can be applied in multi-family dwelling units already provided with a boiler, preferably a gas-fired boiler for heating them.

It was never thought till now of providing a cooling module which could be associated to a boiler, preferably a gas-fired boiler used for heating multi-family dwelling units or little single-family dwelling units provided with an independent heating system for obtaining in the summer period the cooling of the dwelling units and this by using the same hydraulic circuit belonging to the boiler.

The present invention aims at meeting these requirements of having the heating in the winter period and the cooling in the summer period by providing an independent and self-contained cooling module. This cooling module can be associated to a boiler, preferably a gas-fired boiler of an already existing heating system for obtaining the cooling of the rooms in the summer periods or it can be installed together with a boiler, preferably a gas-fired boiler as a combined heating and cooling system employing fancoils as heating and cooling terminals.

According to the present invention, the cooling module to be associated to a boiler, preferably a gas-fired boilers of independent heating systems for multi-family or single-family dwelling units having fancoils as heating and cooling terminals and a single hydraulic circuit leading thereto is characterized in that it comprises:



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⑳ Cooling module to be associated to boilers of independent heating systems.

⑳ The cooling module for boilers, preferably gas-fired boilers of independent heating systems of multi-family or single-family dwelling units having fancoils as heating and cooling terminals and a single hydraulic circuit leading thereto comprises a heat exchanger (2) acting as an evaporator of a refrigerant system, a circulation pump (P2) for the cooling water, an accumulator (10) of heating and cooling medium, a switching valve (V3) for connecting said single hydraulic circuit to the boiler during the winter period and to the cooling module during the summer period, an external motor-operated chilling unit (MC) to be arranged outdoor, and connecting means (A,B,C,D) for connecting the cooling module to the boiler, for connecting said heat exchanger (2) to said external motor-operated chilling unit (MC) and for connecting said module to said single hydraulic circuit (5,6) leading to the fancoils (F1,F2,F3...). A central control unit (16) controls the operation of the pump (P2), the three-way valve (V3) and the fans (32) of the fancoils (F1,F2,F3...).

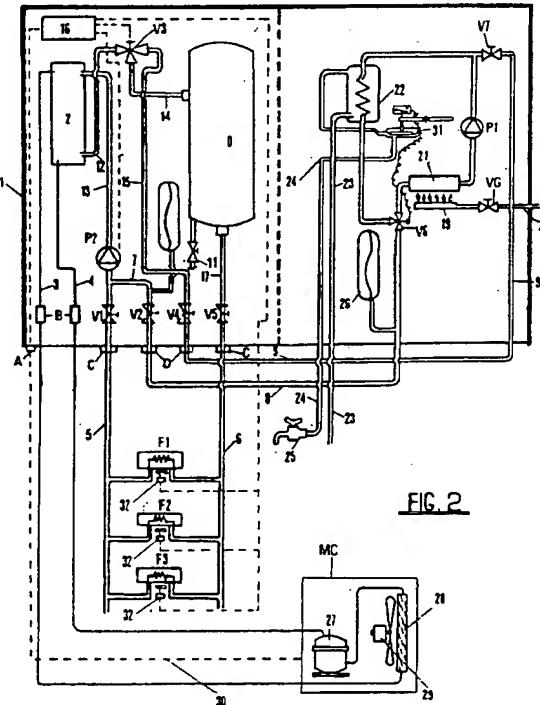


FIG. 3

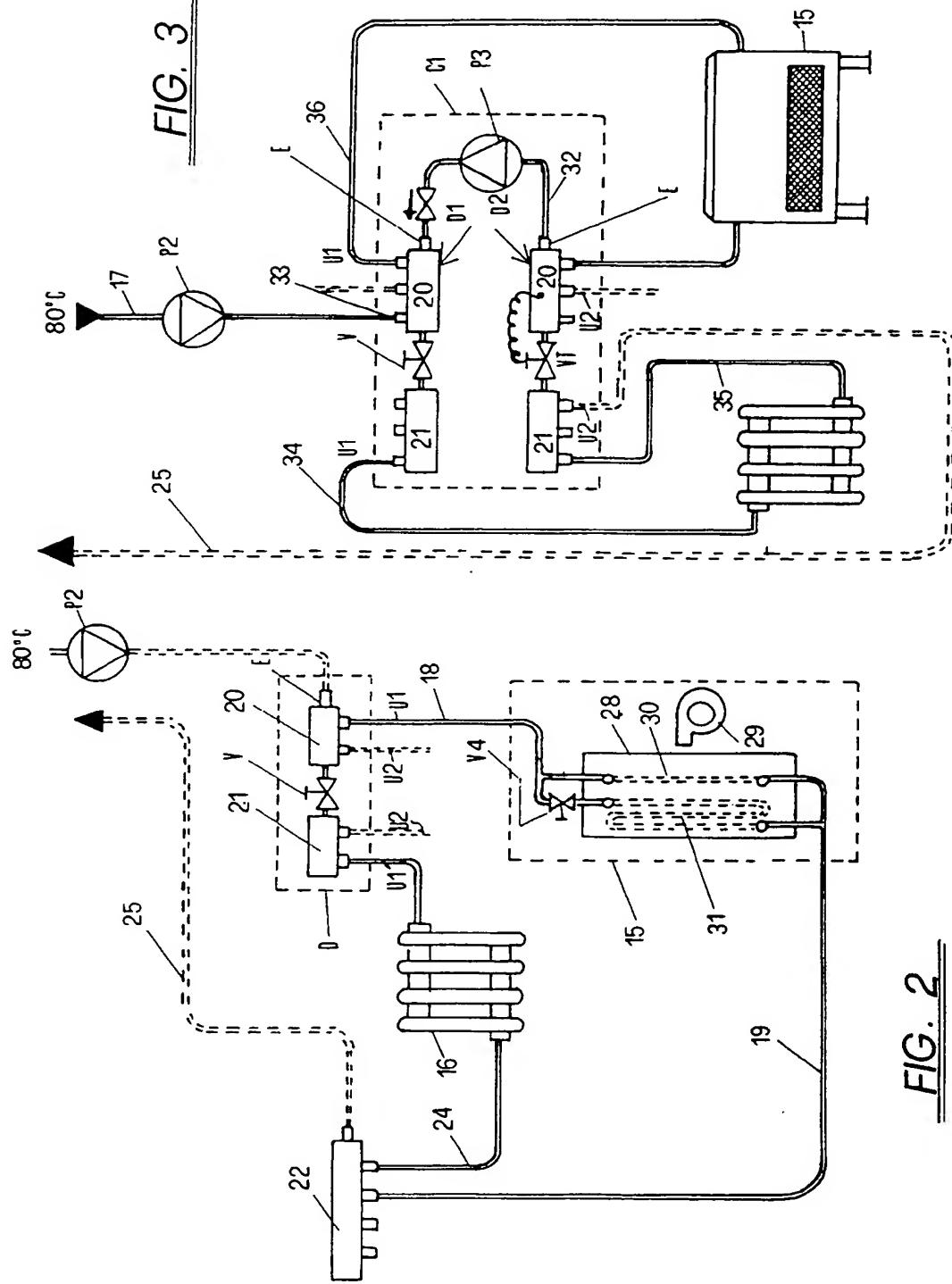
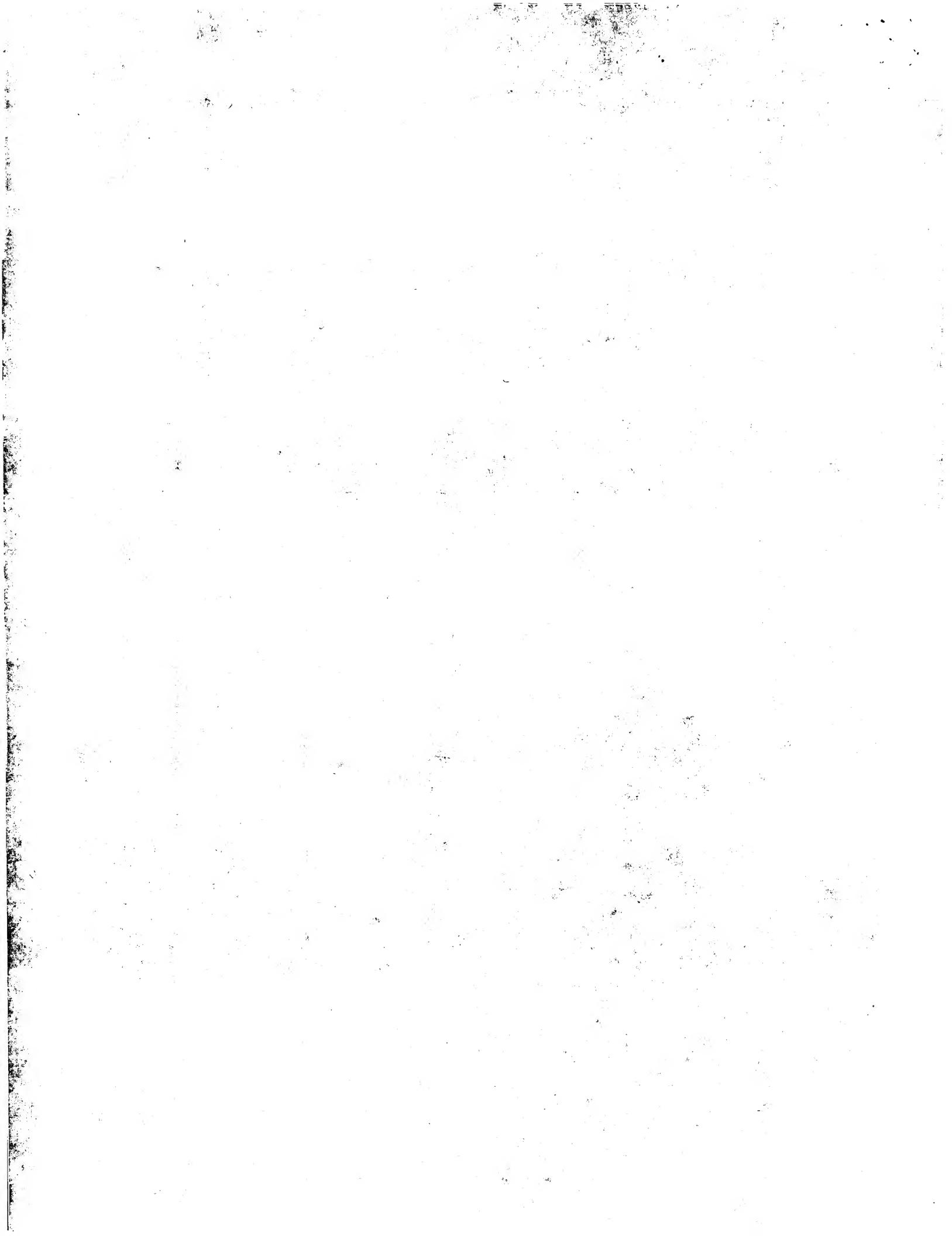
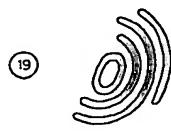


FIG. 2





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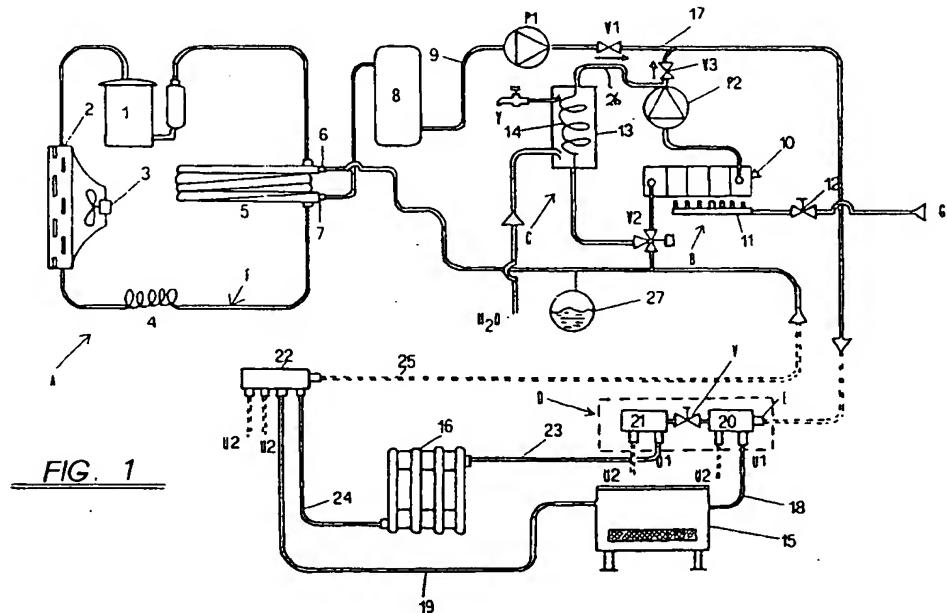
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## ⑤ Monobloc heating and cooling system.

(57) The monobloc heating and cooling system groups in a single block the refrigerating and heating units (A,B) and comprises manifolds (D) formed of two sections (20,21) connected to each other by valving means (V). A single hydraulic circuit (17,25)

is provided which connects the single block to the manifolds (D) and the manifolds (D) to the heating and cooling elements (16,15) provided for heating and cooling the rooms.





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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 1669

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	US-A-4 798 240 (GERSTMANN ET AL.) * column 3, line 37 - column 5, line 40; figure 1 *	1,5	F24F3/06 F24F5/00
A	---	2,3	
A	US-A-2 121 625 (CRAGO) * page 1, right column, line 52 - page 2, left column, line 32; figure 1 *	1,2,4	
A	US-A-2 984 460 (GARDNER ET AL.) * column 2, line 4 - column 3, line 19; figures 1,2 *	1-3	
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			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F24F
<p>The present search report has been drawn up for all claims</p>			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	08 SEPTEMBER 1992	PESCHEL G.	
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			